

CLAIMS

1. A system for generating a display of a body structure comprising:
a sensor positionable at an internal body site for sensing a non-visible field of a
body structure at the site and generating a sensor signal indicative of the field;
5 a transformation system for transforming the sensor signal into virtual image
data;
a source of visual image data for the site; and
a visual system enabling combined display of the visual image data and the
virtual image data.
- 10 2. The system of claim 1, wherein the non-visible field is at least one of an electrical
field, a thermal field, an infrared field and a radioactive field.
3. The system of claim 1, wherein the sensor is at least one of a voltage sensor, a
15 thermal sensor, an infrared sensor, and a radioactive sensor.
4. The system of claim 1, wherein the sensed field is associated with at least one of
a nerve, nerve bundle and vascular vessel.
- 20 5. The system of claim 1, further including:
a stimulator emitting a stimulation signal for at least one of enhancing and
generating the field.
6. The system of claim 1, further including:
25 a tele-robotic system having a slave station with a medical implement and a
master station with a user interface at which user input occurs to control the medical
implement, wherein the visual system is provided at the master station.
7. The system of claim 1, wherein the transformation system includes, for at least
30 one select site, an associated signature value of the virtual image data.
8. The system of claim 1, wherein the virtual image data defines a boundary of the
field.

9. The system of claim 5, wherein the stimulator emits at least one predefined stimulation signal for an associated body site.
- 5 10. A method for generating a display of a body structure comprising:
sensing at an internal body site a non-visible field of a body structure at the site
and generating a sensed signal indicative of the field;
transforming the sensed signal into virtual image data;
providing visual image data for the site;
10 displaying in combination the visual image data and the virtual image data.
11. A system for obtaining virtual image data of a body structure comprising:
a computer-controlled instrument for positioning a sensor at an internal body site;
the sensor sensing a non-visible field of a body structure at the site and
15 generating a sensor signal indicative of the field; and
a transformation system for transforming the sensor signal into virtual image
data.
12. The system of claim 11, further including:
20 a visual system enabling a display of the virtual image data.
13. The system of claim 12, further including:
a tele-robotic system having a slave station with a medical implement and a
master station with a user interface at which user input occurs to control the medical
25 implement, wherein the visual system is provided at the master station.
14. The system of claim 11, wherein the non-visible field is at least one of an
electrical field, a thermal field, an infrared field and a radioactive field.
- 30 15. The system of claim 11, wherein the sensor is at least one of a voltage sensor, a
thermal sensor, an infrared sensor, and a radioactive sensor.

16. The system of claim 11, wherein the sensed field is associated with at least one of a nerve, nerve bundle and vascular vessel.

17. The system of claim 11, further including:

5 a stimulator emitting a stimulation signal for at least one of enhancing and generating the field.

18. The system of claim 17, wherein the stimulator emits at least one predefined stimulation signal for an associated body structure.

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19. The system of claim 11, wherein the transformation system includes, for at least one body structure, an associated signature value of the field.

20. The system of claim 11, wherein the virtual image data defines a boundary of the field.

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21. The system of claim 11, wherein the sensor is disposed at a distal end of a medical instrument.

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22. The system of claim 21, further including:
a medical implement also disposed at the distal end of the instrument.

23. The system of claim 22, wherein the medical implement includes a tool used to perform a medical procedure at the site.

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24. The system of claim 11, further including:
a hand-engageable user interface providing input to a computer for positioning of the instrument.

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25. The system of claim 24, wherein the user interface is part of a tele-robotic master station.

26. The system of claim 12, wherein the virtual image data is provided in the display as at least one of a landmark area and an avoidance area.

27. The system of claim 11, wherein the transformation system includes:
5 modeling data for associating the virtual image data with locations at the site.

28. A method for obtaining virtual image data of a body structure comprising:
positioning by computer control a sensor at an internal body site;
sensing a non-visible field of a body structure at the site and generating a sensed
10 signal indicative of the field; and
transforming the sensed signal into virtual image data.

29. A system for controlling manipulation of a medical implement comprising:
a sensor positionable at an internal body site for sensing a non-visible field of a
15 body structure at the site and generating a sensor signal indicative of the field;
a transformation system for transforming the sensor signal into a feedback signal;
a control system, including a haptic user interface, for manipulating a medical
implement at the site, the control system receiving the feedback signal and in response
thereto providing a tactile signal at the user interface.

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30. The system of claim 29, wherein the tactile signal is at least one of force and vibration.

31. The system of claim 30, wherein the tactile signal is implemented at the user
25 interface as at least one of force and vibration.

32. The system of claim 29, wherein the user interface is at least one of a hand-held holder for the medical implement and a tele-robotic interface for the medical implement.

33. The system of claim 29, wherein the transformation system enables real-time
30 implementation of the feedback signal.

34. A method for controlling manipulation of a medical implement comprising:

sensing a non-visible field of a body structure at an internal body site and
generating a sensed signal indicative of the field;
transforming the sensed signal into a feedback signal; and
utilizing the feedback signal to provide a tactile signal at a haptic user interface
5 for controlling manipulation of a medical implement at the site.

35. A system for controlling manipulation of a medical implement comprising:
a sensor positionable at an internal body site for sensing a visual image of a body
structure at the site and generating a sensor signal indicative of the image;
10 a transformation system for transforming the sensor signal into a feedback signal;
a control system, including a haptic user interface, for manipulating a medical
implement at the site, the control system receiving the feedback signal and in response
thereto providing a tactile signal at the user interface.

15 36. The system of claim 35, wherein the tactile signal is at least one of force and
vibration.

37. The system of claim 36, wherein the tactile signal is implemented at the user
interface as at least one of force and vibration.

20 38. The system of claim 35, wherein the user interface is at least one of a hand-held
holder for the medical implement and a tele-robotic interface for the medical implement.

39. The system of claim 35, wherein the transformation system enables real-time
25 implementation of the feedback signal.

40. A method for controlling manipulation of a medical implement comprising:
sensing a visual image of a body structure at an internal body site and generating
a sensed signal indicative of the image;
30 transforming the sensed signal into a feedback signal; and
utilizing the feedback signal to provide a tactile signal at a haptic user interface
for controlling manipulation of a medical implement at the site.